

## CLAIMS:

1. An optical element (200; 300) for providing a variable refractive surface, the element comprising:
  - a chamber (215) defined by at least one side wall (270);
  - an optical axis (90) extending through the chamber (215);
  - 5 - the chamber (215) containing a first fluid (220) and a second fluid (230) in contact over a meniscus (225) extending transverse the optical axis (90), the perimeter of the meniscus being constrained by said side wall (270), the fluids (220, 230) being substantially immiscible and having different indices of refraction;
  - a first electrowetting electrode (242; 243) arranged to act on at least a portion
  - 10 of the meniscus perimeter constrained by said wall (270); and
  - a second electrowetting electrode (280) extending through the meniscus (225).
2. An element as claimed in claim 1, wherein the second electrode (280) extends along the optical axis (90).
- 15 3. An element as claimed in claim 1 or claim 2, further comprising a voltage control system (240, 285; 400) for providing a voltage to said first electrowetting electrode (242, 243) and a voltage to said second electrowetting electrode (280) to form a predetermined meniscus configuration.
- 20 4. An element as claimed in claim 3, wherein a predetermined configuration comprises the meniscus (225) being substantially flat, and extending in a plane substantially perpendicular to the optical axis (90).
- 25 5. An element as claimed in claim 3 or claim 4, wherein a predetermined configuration comprises the meniscus (225) being non-planar, but with the perimeter of the meniscus (225) in contact with said side wall (270) being at substantially the same position along the optical axis (90) as the position at which the meniscus (225) contacts the second electrode (280).

6. An element as claimed in any one of the above claims, wherein the element (300) further comprises at least a third electrowetting electrode (244, 245, 246) arranged to act on a portion of the perimeter of the meniscus separate from the portion of the meniscus acted upon by the first electrowetting electrode (243).
7. An element as claimed in any one of the above claims, wherein at least one of said side walls (270) is inclined at an angle relative to the optical axis (90).
8. An element as claimed in any one of the above claims, wherein the first and the second fluids (220, 230) have substantially the same density.
9. A device (1) comprising an optical element (200) for providing a variable refractive surface, the element comprising:
- a chamber (215) defined by at least one side wall (270);
  - an optical axis (90) extending through the chamber (215);
  - the chamber (215) containing a first fluid (220) and a second fluid (230) in contact over a meniscus (225) extending transverse the optical axis (90), the perimeter of the meniscus (225) being constrained by said side wall (270), the fluids (220, 230) being substantially immiscible and having different indices of refraction;
  - a first electrowetting electrode (242; 243) arranged to act on at least a portion of the meniscus perimeter constrained by said side wall (270); and
  - a second electrowetting electrode (280) extending through the meniscus (225).
10. A device as claimed in claim 9, wherein the device further comprises a meniscus control system (400).
11. A device (1) as claimed in claim 9 or claim 10, wherein the device is an optical scanning device for scanning an information layer (4) of an optical record carrier (2), the device comprising a radiation source (11) for generating a radiation beam (12, 15, 20) and an objective system (18) for converging the radiation beam on the information layer (4).
12. A method of manufacturing an optical element (200; 300) for providing a variable refractive surface, the method comprising:

- providing a chamber (215) defined by at least one side wall (270), with an optical axis (90) extending through the chamber (215);
  - filling the chamber (215) with a first fluid (220) and a second fluid (230) such  
5 that the fluids (220, 230) are in contact over a meniscus (225) extending transverse the optical axis (90), the perimeter of the meniscus (225) being constrained by said side wall (270), the fluids (220, 230) being substantially immiscible and having different indices of refraction;
  - providing a first electrowetting electrode (242; 243) arranged to act on at least  
10 a portion of the meniscus perimeter constrained by said wall (270); and
  - providing a second electrowetting electrode (280) extending through the meniscus (225).
13. A method of manufacturing an optical device (1), the method comprising the  
15 step of:
- providing an optical element (200; 300) for providing a variable refractive surface, the element comprising:
    - a chamber (215) defined by at least one side wall (270);
    - an optical axis (90) extending through the chamber (215);
    - 20 - the chamber (215) containing a first fluid (220) and a second fluid (230) in contact over a meniscus (225) extending transverse the optical axis (90), the perimeter of the meniscus (225) being constrained by said side wall (270), the fluids (220, 230) being substantially immiscible and having different indices of refraction;
    - a first electrowetting electrode (242; 243) arranged to act on at least a portion  
25 of the meniscus perimeter constrained by said side wall (270); and
    - a second electrowetting electrode (280) extending through the meniscus (225).